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UMU-305

INSTITUTE OF CORRESPONDENCE EDUCATION

I N D I A N M U S I C

B.A. DEGREE COURSE

Third Year

APPLICATION ORIENTED SUBJECT

Teaching Aids and their applications in Music

(English Medium)

Package–1

UNIVERSITY OF MADRAS
MADRAS-600 005.

B A. Degree Course

Application Oriented Subject
Teaching Aids and their applications in Music
(English Medium)
Package—I

WELCOME

Dear Student,

We welcome you as a student of the Third Year B.A. Degree Course in Indian Music.

This subject deals with "Teaching aids and their applications in Music" which is [illegible] offered under the third year of your course [illegible] Application Oriented Subject. This forms a part of the course of study [illegible] the third year of the Course.

The learning materials for this paper is being sent to you and will be supplemented by a few contact classes.

You may be aware that learning through correspondence involves a great deal of self-study. We hope that you will put in your whole-hearted efforts.

On our part we assure you of our help in guiding you throughout the course.

Wish you all success.

DIRECTOR

Teaching Aids and their applications in Music

I General survey of Teaching aids used in education. Outline knowledge of - Graphic representation, photographs, mechanical aids and models, electronic aids.

II Scope of aids in the teaching of Theory of music and Practical.

III Detailed study of the application of -
a) Charts, Albums, Maps, Photographs
b) Demostration musical instruments (pradarsana vina), metronome.
c) Electronic Audio, Video Equipments; Electronic talometre
d) Computer.

SCHEME OF LESSONS

Lesson no.	
1	General survey of Teaching aids used in education. Outline knowledge of - Graphic representation, photographs, mechanical aids and models, electronic aids.
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5	Detailed study of the application of - Computer

OVERVIEW

This package of learning material contains lesson no.3 & 5.

LESSON No. 3

Detailed study of the application of
a) Charts, Albums, Maps, Photographs
b) Demonstration on Musical Instruments (pradarSana vINA) and Metronome.

Visual aids are very necessary in the teaching of any subject including fine arts. Though music is taught through lip-ear method in ancient times, teaching the subject through various aids help the teacher to teach well, as well as for the pupils to grasp the subject matter easily.

Various aids such as graphs, charts, Maps, Albums, Photograph and demononstration on instruments can be utilised in teaching music. Some of the facts, laws and phenomena relating to music can be imported through visual media. The eye plays an important part as the ear in the assimilation of facts relating to music. Seeing is learning. The music teacher as well as the pupils can prepare the aids especially charts.

Aids to the teaching of music may be classified into
1. Graphs
2. Charts
3. Maps, Album, Photographs and demonstration on various instruments.

Graphs :

Any song or any technical form is taught in a rAga. The ArOhaNa and avarOhaNa of the rAga will help the pupil to know the svaras taken by the rAga. When the ArOhaNa and avarOhaNa are learnt quickly by the gifted children after hearing them once, the average pupil will learn them slowly. But visual representation of the ArOhaNa and avarOhaNa will be helpful to learn better. Whether the rAga is varja, bhAashanga or vakra can be visually seen through the graph. The difference in singing the kOmala type of from tIvra type is visually saperated, for example the interval between shaDja to Suddna-rshabha and shaDja to catuhSruti-rshabha is seen visually, so much so the pupil understand how much he has to the pitch for Suddha-rshabha or catuhSruti-rshabha from the basic note. In the graphs there are two types.

[illegible]ara graphs
[illegible]na graphs.

[illegible]raphs the vertical arm has 7 [illegible] horizontal arm, the [illegible] are marked with time units. [illegible] number of svara-s in [illegible] together, there will

be 14 units in the horizontal arm. In the case of dIrgha svara, for example, in the avarOhaNa of jaganmOhini rAga "SA nu pa ma gu , ra sa" - ga will have two units. In svara graphs varja rAga will tell the skipped notes and vakra will show the zig-zag pattern.

svarasthAna graphs : are drawn on the basis of kinds of svara-s taken by the rAga. Vertical arm shows 12 units, and along with octave note there are 13 units and in horizontal arm total numer of svara-s of ArOhaNa, avarOhaNa and octave will be marked as number of units. For dIrgha svara two units will be set apart. The svarasthAna graphs will show at a glance whether a semitone or major tone or an agumented tone exists between two contiguous notes. It will also be helpful in understanding the rAga-s, with same type of ArOhaNa-avarOhaNa. For example, rEvagupti and mOhanam.

CHARTS

Charts for the following topics and musical terms can be prepared.

1. Parallelism in alankAra-s
2. Notation
3. vINA finger board
4. 35 - tAlam
5. Compass of musical instruments
6. Sangati
7. Cycles of fifth and fourth

1. PARALLELISM IN alankAra-s

This chart is drawn to give a visual [illegible] to a student how the music in each Avarta of a [illegible] has a similar melodic flow. Whatever paths [illegible] in the first Avarta is imitated in the [illegible] with one svara being augmented in the [illegible]

See the chart at the end [illegible]

[illegible]

The notation chart will consists of all sings used in the script [illegible] of South Indian Music. The seven svara-s, sthAyi, [illegible] tAla-s, varieties of laghu, gamaka-s [illegible] as the notation adopted in South Indian

2a. tAla aNga-s CHART

This chart will give a list of the aNga-s used in tAla along with the symbols for denoting. e.g., the shaDaNga-s

anudrutam	U
drutam	O
laghu	I
guru	8
plutam	8'
kAkapAdam	+

Signs are written in bold letters in the chart.

3. vINA finger-board CHART

Chart on vINA finger-board is given with the svarasthAna of a particular mEla or rAga shaded. This will help the students, to know what notes to be played for a particular rAga.

4. 35-tAlam CHART

In this chart the tAla-s can be presented from left to right in the decreasing order of their magnitude.

5. Compass of Musical Instruments

Charts on compass of musical instruments show visually the number of octaves that can be played on the various musical instruments.

6. saNgati CHART

saNgati-s are variation of a theme and these variations can be visually shown through the help of a chart. This chart will help a strudent to remember where the variation taken place in the theme whether beginning middle or end on the whole theme. Change of the theme is indicated by wavy lines

7. CHART on Cycles of FIfths and Fourths

Chart on cycle of fifths and fourths can also be given by writting down all the notes derived through the cycles fifth and fourth. Any number of charts can be drawn according to th[illegible]ity of the students. The above charts are only some ex[illegible]

THE MUSICAL MAPS

The musical maps of a country shows the important seats of music composer place of birth and death places, music academy, institution and places of manufacture of instruments. Maps dealing with the life of composers, e.g., indicating the kshEtra-s visited by muttusvAmi dIkshitar can also be used.

ALBUMS AND PHOTOGRAPHS

Every teacher should have an album, on the subject and collection of photographs and article on the subject. This hold good for any music teacher too. Album should consists of any topic in the music, Composer, musicians, instrument, dance, picture of various place of musical importance etc., Throughout her or his life, a music teacher should collect pictures and add to the album and photographs.

Various instruments especially rare instruments can be utilised to know the structure. Otherwise picture of the instruments can be shown. A teacher should demonstrate some of the main instruments to know about the playing method.

MUSICAL INSTRUMENT FOR DEMONSTRATING THEORETICAL CONCEPTS AND AS AID FOR TEACHING PRACTICAL

pradarSana vINA :

Instruments like pradarSan vINA will be an important aid in the learning of Music. This instrument was devised by Professor P SambamUrti. This instrument (only one are two) is found in Sangeetha Vadyalaya, Mayilapur and in the University of Madras. The Main purpose of this instrunment is education.. This instrument can be used as a concert instrument. It is a good audio visual aid for understanding music and its laws. Though good in finding out the various fact, due to it Complexity it has become obsolete.

Structure and construction of pradarSana vINA :

The instrument is five feet four inches in length. It resembles a gOTTuvAdyam. It has 40 strings --

4 for the tamburA
5 for the gOTTuvAdyam
3 drone-cum-tAla strings.
14 strings - 7 for the dhruvavINA, 7 for the cala-vINA passing under the playing strings

7 pairs of strings (total 14) on the top of the bowl and radiating from the centre for explaining the derivation of ancient mUrcchanA and for performing experiments relating to modal-shift of tonic.

The teacher should be thorough in this instrument before he/she demonstrate on it.

Metronome :

Metronome is another instrument which help a student to regulate tAla and improve tAla jñAnam. It is a device to mark time at a steady beat in adjustable intervals used especially as an aid for keeping time in practising music. This instrument is used frequently in western music. Latest instrument, an improvement on this instrument is Electronic tala-metre which is most suitable for Indian Music.

NOTE : For illustrations of Charts, Graphs etc. students are advised to consult the following book.

AIDS TO THE TEACHING OF MUSIC by P.Sambamurthy published by The Indian Music Publishing House, No.14 Sripuram First Street (Near Ajantha Hotel), Royapettah, Madras 600014.

LESSON No. 5

MUSICAL APPLICATION OF COMPUTERS

1. INTRODUCTION

1.1 The computer has become a modern tool which can be used in practically every aspect of life. No wonder that it is being widely used for applications connected with music, especially western music.

1.2 Basically a computer is a machine like any other machine. What makes it versatile is its ability to store very complex and lengthy instructions and act according to these instructions. In particular these instructions may involve decision to take one action or other according to the results of a previous action. Thus the computer is made to imitate the human behaviour. The advance in electronics technology has made it possible to inter-link the computer with other equipment like audio systems making it possible to use the computer for applications connected with music.

2. COMPUTER - A BRIEF DESCRIPTION

2.1 Although the design and functioning of a computer is complex, we can describe its parts and functioning in a simplified manner.

2.2 The computer stores and works only with numbers and every thing has to be converted into numbers for the computer to handle. That is why the computers we normally use are called 'digital computers'. Even characters like A,B,C are stored as numbers. Actually the computer works only with numbers 1 and 0 (represented by flow of current or the absence of it or positive and negative charges and many other variations). Thus we have two digits 0 and 1 to represent all numbers instead of the ten digits 0 to 9 we normally use. But applying the same principle of writing 10, once we exhaust 0 and the nine digits we can build up number system using only 0 and 1 (0,1,10,11,100 etc.). In the computer each digit is called a 'bit' and a group of 8 bits is called a byte. A thousand bytes (to be precise 1024 bytes) get the name kilobyte. A megabyte is about a million bytes (1024 X 1024). To measure the capacities of various parts of the computer which store data we commonly use the terms kilobytes and megabytes.

2.3 There is a Central Processing Unit (CPU) in a computer which actually controls and carries out the processing. There is a temporary memory called DRAM (Dynamic Random Access Memory) where the numbers are stored temporarily and there are many auxiliary storage devices like Floppy disks, Hard disks, tapes etc. to store the data permanently. In

these media the data is stored in a fashion similar to the audio tape - by magnetising particles. The floppy disks are removable storage media and the Hard disk is a fixed medium (often called the fixed disk). However, removable hard disks are now available. The data is written and read by a head (similar to the audio tape recorder head). The hard disk is based on very fine technology and data can be written and read from a hard disk many times faster than from or to a floppy disk. Hard disks are also of much larger capacities.

2.4 In addition to these we also have input devices like the keyboard or a mouse or in the case of music a microphone or a MIDI instrument (see later). We have a monitor (the TV type of screen) where we can see what we are typing or get the results of the programs run.

2.5 These parts of the computer are called the hardware - the physical components. The programs written to be run on the computer are called the Software. These may be programs written by the user or ready-made programs written by someone else which can be used with minimum learning by the user (which are called "packages".)

2.6 In earlier days the instructions were written actually in numbers as understood by the computer (this is called machine language), but subsequently programs were written to enable instructions to be given in English like language and convert these instructions into numbers for execution by the machine. These conversion programs are called "language translators" and there are hundreds of them. Each of them has its own "syntax" i.e. the manner in which the instructions are to be written. These are called "high level languages". These include the commonly used languages like BASIC, COBOL, PASCAL, C etc. When I say that I have written a program in BASIC I mean that I have written instructions in what looks like ordinary English (of course according the syntax of BASIC) which can be converted into the machine language using a BASIC language translator.

2.7 Apart from the programs written by the user and the translators, to run a computer a number of other programs are required. These come along with the computer, or sometimes purchased and added. One such set of programs is the Operating System which gets the computer ready for use and takes care of many areas like maintaining and managing the files, managing the computer's memory etc. In India the IBM PC and its compatible working with MS-DOS operating system is the most popular PC system.

2.8 A commonly used word to measure the size of instructions or the size of data is the 'byte' (as mentioned earlier it consists of 8 bits.) A byte can have 256 different values (2 multiplied by itself 8 times). A byte may be roughly equated

to one character. Nowadays even Personal Computers have auxiliary storage devices which can store as much as fifty crores of characters! Floppies commonly store between 3.6 and 14 lakhs of characters and are useful for distribution of programs and for backup.

3. EXAMPLE OF A SIMPLE PROGRAM

BASIC (Beginner's All Purpose Symbolic Instruction Code) is a language easy to learn but earlier versions had many limitations especially for developing a large application. The Basic Interpreter is supplied along with the MS-DOS operating systems which is the operating system used in majority of the PC's especially in India.

3.1 The problem is to find the cost of certain materials given the number of items and the rate. This can be done easily with a calculator. But if a condition is put that where the total cost of items purchased is more than Rs.100 a discount of 5% is given, then a calculator cannot give the answer straight-away. You have to first calculate the cost and then work out the discount if the cost is more than 100. Suppose you want to write a program for this in BASIC it will look like this:

```
INPUT "Enter number of items ", NUM
INPUT "Enter the rate ", RATE
COST = NUM*RATE
IF COST > 100 THEN DISCOUNT = COST*5/100 ELSE DISCOUNT=0
PRINT "Gross Cost ";COST;"Discount ";
PRINT "Net Cost ";COST-DISCOUNT
```

3.2 This almost looks like English except for use of the words INPUT, NUM,RATE,DISCOUNT and some symbols. The first two line display on the computer screen whatever is in quotation marks and then wait for the user to enter the value. In the first line the value entered (for the number of items) will be kept in the variable (identifier) NUM and in the next line the value (rate) will be kept in the variable RATE. This is very much like algebra but we are allowed to use words instead of only letters. Because of this there is no implied multiplication as in algebra. The symbol for multiplication in computers is the star *. The third line calculates the cost by multiplying the number by rate. The fourth line is a typical computer decision making instruction. If the cost is more than hundred (the symbol '>' means greater than). If this condition is true the next statement DISCOUNT=COST*5/100 will be executed by the computer. If this conditions is not true the statement following ELSE will be executed. The last two lines help to display the results of the calculations on the screen. In BASIC the command PRINT displays on the screen and the

command LPRINT prints on the printer.

3.3 To enter and run the program the BASIC interpreter has to be first invoked by typing the command GWBASIC or QBASIC according to which program is available in the PC. If it is GWBASIC the lines have to be numbered (the practice is to number them by tens i.e 10,20,30 etc. so that you can insert some instruction in between later). If it is QBASIC line numbers are not needed. You have to then type RUN and press Enter key in GWBASIC or using the menu run the program in QBASIC.

3.4 Suppose you want to produce some music, for instance the ArOhaNam of SaNkarAbharaNam in plain notes the following lines are required:

```
SOUND 264,10:SOUND 0,2
SOUND 297,10:SOUND 0,2
SOUND 330,10:SOUND 0,2
SOUND 352,10:SOUND 0,2
SOUND 396,10:SOUND 0,2
SOUND 440,10:SOUND 0,2
SOUND 495,10:SOUND 0,2
SOUND 528,10:SOUND 0,2
```

The statement SOUND is for producing the sound and the first number is the frequency. The next number is the duration of the sound (a unit of 1 represents 1/18 th of a second-10 will be about half a second). To get a silence for the required duration we give the frequency as 0. The colon : is to separate two statements which could have been written in two lines.

3.5 If you do not want to be bothered about the frequencies and are satisfied with the European equally tempered scale a much simpler command can be used:

```
PLAY "cdefgab>c<"
```

The notes are here written in European notation and the normal duration will be . The symbol '>' takes the last c to the higher octave and and '<' brings the PC back to the lower octave for further music. Each note is played for 7/16 seconds with a pause of 1/16 second. There are different symbols to vary the note duration and also for producing notes corresponding to the black keys. For example for Mayamalavagowla, Arohanam and Avarohanam the command would be:

```
PLAY "cd-efga-b>c"
PLAY "c<b-agfed-c"
```

The minus '-' symbol after d and a (ri and da) reduce the notes by one semitone. There are many other symbols to achieve different effects.

3.6 One thing should be clear from the above. The programmer has to break down the actions to be performed by the computer into commands which are available in the particular language.In fact the computer does not do anything on its own but only carries out the instructions given by the program. The symbols and other commands should be exactly as required by the particular language. If there is even a spelling mistake the computer will not guess like a human being. For instance if the command SOUND is misspelt as SOUNT the computer will show a "syntax error" and stop.

4. MUSIC ON THE COMPUTER-USING PC-SPEAKER

4.1 Though there are a variety of computers - in terms of size, speed sophistication etc., it is the Personal Computer (PC) which has been widely used in the musical field. In particular the IBM-PC and its clones and the Apple PC are very useful for running programs which produce music.

4.2 Till a decade ago the music was generally produced through a speaker built in the PC. This speaker was mainly intended to give warning sounds or beeps but there was provision to make it sound any desired frequency. As given in the examples in para 3 GWBASIC and QBASIC have a statement SOUND to make the PC speaker produce sounds of desired frequency.

4.3 Other language translators like the Turbo C and Turbo C++ compilers have similar facilities for producing a sound of desired frequency for the required time, but languages which were mainly written for commercial data processing (like COBOL) may not have the required commands. In Turbo C there is a function called sound (unsigned freq) which starts the sound of the given frequency. Another function nosound (void) stops the sound while yet another function delay (unsigned milliseconds) enables fixing the duration. Even in the case of BASIC and C the standard definition of the language does not have the commands for producing sound but the translators written for use on a PC have the commands. (The word "command" is loosely used here to enable the layman to understand it. The production of sound will require "statements" or "call to functions" according the language.)

4.4 The main drawback in using the PC speaker for music is that we have no control over the quality of sound or its volume. For a musical note to be rich in quality it has to

have many harmonics (or integral multiples of the basic frequency) in addition to the basic frequency. The proportion of these harmonics relative to the basic frequency decides the quality or timbre of the sound. In the PC speaker simple 'square wave' is generated and depending on the size of the PC speaker and the circuitry, it may sound like flute or a viola or even a nAgasvaram at low frequencies. There is no way we can control the volume smoothly. Inspite of this limitation we can write programs to produce impressive music - even karNaTaka Music, which of course requires considerable effort as we have to incorporate gamakam and also there is minor variation in the frequency of the same note in different rAgam-s.

4.5 Just before the advent of the IBM Personal Computers, simpler computers were in the market. These can be used by connecting to the TV (Sinclair, Commodore and BBC Acorn). These were called Home Computers and could be programmed only in BASIC but in the Commodore and BBC Acorn provision was available to produce much better quality of sound and also control the volume. These could be very effectively used to write programs for generating music but the limitation was the language and the difficulty in trans-ferring and distribution of the programs in the earlier days when these computers did not have any floppy drives. Subsequently floppy drives were added. However, the advent of the IBM-PC and the Apple PC, which are very versatile and can be used to write programs in many languages and for which a large number of program packages are available had virtually closed the market for the Home Computers.

5.MUSIC WITH SOUND CARDS-VOICE FILES

5.1 The other and more sophisticated way to use the PC for music is to use a 'Sound Card' or a 'multimedia kit' which includes a sound card. (A card is a printed circuit board containing various electronic components like transistors, IC's, VLSI's, resistances, capacitors etc.). We have to buy a sound card or multimedia kit and insert it in the PC in an "expansion slot" and use the software supplied with sound card or the multimedia kit. A sound card produces music in two different ways.

5.2 The sound card contains two set of 'chips' (a very large scale integrated circuit). One set is the Analogue Digital Converter (ADC) and the Digital Analogue Converter(DAC). You can connect a microphone to the sound card and record any sound - music, speech etc. The sound is 'sampled' many thousand times in a second (typically between 5000 and 14000 times) and the amplitude of the sound wave at that particular moment is converted into a number by the ADC and stored. The music that we feed into the microphone is in

'Analogue' form i.e. the strength of the current varies according to the amplitude of the sound wave. The Analogue Digital Converter changes this into digits or numbers. Thus for recording music of 1 minute at a sampling rate of 8000 we will get 8000 X 60 or 480,000 numbers. If great accuracy in the volume is needed we may have to represent each number by at least 2 bytes. Thus one minute of music will produce nearly a million numbers. These numbers are stored in a file usually with an extension .voc or .wav. (These are called "Voice files"). From these numbers you can get back the original sound with the Digital Analogue Converter which converts the numbers into electric current with the same strength as the original sound wave at each point. This sound is heard through speakers attached to the sound card.

5.3 In a way the PC becomes a recording machine like a tape recorder but the advantage is that we can edit this recording-cut out portions, join portions, repeat some parts, add echoes, taper the sound, add echoes etc. The editing is restricted to handling portions of the sound. It is not possible to change the frequency of a particular note in the recording. We can also access different files instantaneously while in the case of a tape recorder we have to run the tape back and forward to get the required song. The recording of music on CD's is done in a similar (digital) fashion and the CD player has DAC to reproduce the music. (That is why the CD is said to store music digitally).

6. MUSIC WITH FM SYNTHESISER

6.1 The other way to record music in a Computer is to use an Electronic keyboard and a MIDI interface and connect it to the sound card. (MIDI stands for Musical Instrument Digital Interface.) Here the sound is not sampled but the various actions of the player on the keyboard such as the key pressed, how fast the key is pressed, how long it is held down etc. are recorded. Thus only the data is recorded and the size of the data will be far less than the data required in the previous method. The files containing music recorded through the MIDI interface have extensions like (or mix prerecorded rhythm) simultaneously and superpose more than one instrument. You can have even 16 'channels' for different melodic instruments and rhythm.

6.2 Since the music is recorded in the form of data it is easier to edit the file so generated. Using special programs it is even possible to change one note or its duration. It is also possible to compose original music using special programs.

6.3 However, for using this procedure to record Carnatic Music we need an advanced Electronic Keyboard (or a synthesizer) as we need to incorporate gamakam. Such advanced instruments have a special control for varying the pitch called "pitch bend". Considerable practice is required to produce true gamakam on a keyboard with pitchbend and the player will also be handicapped in that he has to use only only hand for the keys while the other is used to control the pitchbend.

6.4 However, using the MIDI very good recording of Western Classical music is possible. In particular polyphonic music (music involving playing different notes at the same time) recordings are possible through a MIDI. Many of the digital synthesizers also enable the creation personlised wave forms and "envelopes" and that is why Electronic Music has been widely used in the west in recent times.

6.5 The total data generated by recording through a MIDI occupies far less space than in the previous method (of actually sampling the sound) and may even be only one fifth. It is also possible to record from the keyboard set to one instrument (for instance Violin) and then play it from the PC with the tone of another instrument (for instance flute)! We can also change the octave, tempo etc. The music produced by the MIDI format can also incorporate vibrato (or rapid change in the pitch) or tremolo (rapid change in volume) used in Western Music for instruments like violin.

6.6 The tones of different instruments with the same music data is produced in this case with a set of chips called FM SYNTHESISER in the sound card. This imitates the wave form of the chosen instrument by some mathematical manipulations but the tone is not 100% similar. New techniques (such as wave table synthesis) are used to produce tones closer to that of the natural instrument.

7. SOUND CARD VS. PC-SPEAKER

7.1 With the increasing use of sound cards in PC's the simple method of producing music with the PC speaker is vanishing. However, the latter has some advantages - very small size of the data, direct appreciation of the connection between frequency and sound and easy transposition to different Sruti-s. Thus for practicing the beginners lessons like saraLi, jaNTa variSai, alankAram etc. programs can be written using the PC speaker and the student can practice in different sruthis and different kAlam-s. If written without gamakam different Melams can also be produced very easily. The ordinary PC speaker sound would be adequate for practice and training the voice. Tape recorded lessons for beginners has the main disadvantage

that the lessons can be practiced only in the Sruti in which lessons have been recorded or one octave lower or higher.

7.2 Some computer programs have been commercially produced for practicing South Indian Art-Music lessons and also for understanding the theory of the Music with audio and visual support and producing gamakam-s. A computer package has also been produced to compose rhythm with tabalA sounds but this requires a sound card.

7.3 It is also possible to write programs which will take the South Indian Music type of notation and play the music. However, we do not yet have an accurate notation for gamakam-s and also the pauses (we write the same note when it is held for the whole of the given time period or if it is held for a shorter period filling the rest of the time period with a pause). Computer programs for composing South Indian Music may have to wait till such time a more accurate notation system is developed and is also widely accepted and used. As it is, any program written to simply read the notes and play them will be quite unacceptable for raagams involving rich gamakam-s or where the rAga svarUpam would be clear only from the gamakam-s.

8. MULTIMEDIA

One of the main advantages of using a computer for producing music is the capability of combining sound with pictures and text. Though such a combination is possible in a video tape the computer is superior in that the user can be made to interact with the computer. He can choose subjects quickly and listen or view what he wants. He can be given opportunity to alter some portion and see the result. The term MULTIMEDIA is used to describe the use of computer for producing pictures (graphics) including animation or moving objects, sound and text. However, since music used in Multimedia is with the help of sound cards the music files require quite a lot of space. The picture files also need considerable amount of space especially if they are in color and high resolution. Consequently Multimedia programs are usually distributed in CD ROMS - disks similar to the audio Compact Disks and therefore the "Multimedia Kit" usually consists of a sound card and a CD-ROM drive which can read a CD-ROM. A computer CD ROM can store as much as 500 mega-bytes or 50 crores of characters but like an old gramophone record you can use it only for reading and you cannot write on it. The word ROM stands for Read Only Memory.

9. COMPUTER FOR MUSIC THEORY AND RESEARCH

9.1 As the computer is also a versatile processor of data, we can use it to teach many theoretical aspects of music with simultaneous production of sound and pictures. For instance we can write programs to explain the theory behind VEnkaTamakhi's 72 mElakartA scheme, illustrate it with pictures and produce the notes of any of the 72 scales. This is possible because the mElakartA scheme is essentially a mathematical organisation of notes. We can write programs to convert the PC into a tAlometer. Commercial programs incorporating these aspects are already available. We can illustrate the correlation between the frequency and notes. Sruti-bhEdam is another technical concept and we can write programs to find out what rAgam-s can be arrived at by taking different notes of a rAgam as the tonic or fundamental.

9.2 On the research side a PC with a Sound Card can be used to record live music and analyse it for frequencies, subtleties in the way different notes are held, how a same note is sung in different rAgam-s etc. Of course for adopting the PC to South Indian Music many new programs will have to be written.

9.3 We can also use the computer to quickly estimate the number of times a particular note occurs in a piece or how many times the same phrase is found in a particular song or a set of songs.

9.4 We can also use the computer to analyse the wave forms of different Indian instruments. Instruments like the vINA or the tambUrA produce notes very rich in harmonics. The computer can be used to analyse the wave forms of instruments whose "nAdam" is very good and try to connect it with the physical manufacture of the instrument and thereby improve the manufacturing process. Thus there is vast scope for using the computers in the field of South Indian Music.

9.5 Attempts have also been made to produce original music with the computer by making it produce random notes. The computer can generate what are called pseudo random numbers. Using this we can generate notes of a particular rAgam randomly but aesthetically it will be quite unacceptable. The rAgam structure in South Indian music is not only based on the notes used, their ArOhaNam, avarOhaNam, gamakam-s used etc. but there are many subtleties especially in the use of gamakam-s, repetitions with minor variations, usage of peculiar phrases etc. An attempt was also made to generate "kalpana-svaram" with the Computer, but these have remained in the realm of curiosity.

10. NON-MUSICAL USES RELATED TO MUSIC

10.1 The computer is an efficient storer of data and enables us to recover the data quickly. Standard data base programs (like dBase V) are so easy to use that we can store, organise and retrieve data without writing detailed programs. This presents some uses for a teaching organisation which will have a number books, audio cassettes, video tapes etc. Apart from simply having the library index on the computer, we can also create an indexed data-base of all the krti-s in all the books in our library. If you want to locate a particular krti this index can quickly give you a list of books with page numbers where the krti is available. Similar indexes for audio cassettes and video tapes will enable quick location of the desired pieces. We can even get a list of all krti-s in a particular rAgam or krti-s in a particular rAgam written by a particular composer, krti-s in a given rAgam sung by a particular artiste etc.!

11 CONCLUSION

The versatility of the computer is waiting to be fully exploited by the South Indian Music world. But we have to remember that the Computer is basically a tool and it is the human ingenuity which puts it to the best use. However, a totally new approach to use of computer has come up in recent times. This is a subject called "Neural Networks" - one of the subdivisions of "Artificial Intelligence", a very important branch of Computer Science. Here the programmer does not give instructions as to how to solve a problem but the computer is made to imitate the human brain and establish its own connections between data and patterns. The computer is put through a "learning" session to learn a particular subject (like pattern recognition of characters of a script) and then use the "knowledge" it has gathered to identify future patterns. It is difficult to predict how the application of this branch of Computer Science to music would open up totally new worlds of musical experience.

A brief glossary of technical terms

ADC: Analogue Digital Converter. An electronic circuit which converts analogue signals into digital output.

Application Software: Software meant to be put directly to some use by the end user without the need to write detailed programs (ex.) dBase V for data base operations, EX - an Indian package for financial accounting. The application software is also called application package or simply package.

BASIC: Beginners All Purpose Symbolic Instruction Code. A high level lan- guage - easy to learn and also available in interpreter mode or as a compiler.

Bit: A Binary DigIT. Ones and Zeros of the binary numbering system. The basic unit of the computer working.

Byte: 8 Bits. A byte can represent numbers 0 to 255 and for textual data a byte can be taken as equal to a character. The byte is the unit of measurement of describing capacities of Memory, Storage devices etc.

C: A high level language generally available as a compiler. Very popular for developing application packages. It also allows some low level access.

CD: Compact Disc. The medium in which digital data is stored as micro- scopic pits and read with the help of a laser beam.

CD-ROM: Compact Disc Read Only Memory. Used for distributing Computer Software where the sizes of the programs and supporting data are very big. CD-ROMs have capacities upto 500 Megabytes.

COBOL: Common Business Oriented Language. A compiler popularly used for commercial (accounting etc.) applications till about a decade ago.

Compiler: A language Translator which converts the high level language program and stores it in the form the computer can understand. After linking it can be run in a computer without the need for the original compiler.

[illegible] Unit. It carries out the basic task [illegible] and controlling the program flow.

DAC: Digital Analogue Converter. An electronic circuit which converts digital signals into analogue form - in

the case of sound signals such analogue signals can then be fed into an amplifier and a loud speaker to produce sound.

DRAM: Dynamic Random Access Memory. Memory in the computer which is active when the power is on and used by the CPU for storing the data. The data will be lost when the computer is switched off. The access to and from DRAM is very fast.

Floppy: (Also called Diskette) A cheap, convenient and transportable storage medium for data and programs. At present Floppy disks of the size 3.5 inches are popular and can store 1.44 megabytes.

FM Synthesizer: An LSI used in Electronic keyboards and Sound Cards to produce sounds of different wave forms thereby imitating many instruments and reproduce the sounds of more than one instrument simultaneously.

FORTRAN: Formula Translation. A high level language popular with Engineering and scientific personal.

Hard Disk: A storage medium with high capacities (now even upto 1000 mega-bytes) which is usually fixed in the computer. Reading to and writing from a hard disk is many times faster than in the case of a floppy.

Hardware: The physical parts of the computer.

IC: Integrated Circuit. It combines in a small space the functions of many transistors, resistances etc. required for electronic circuits.

Identifier: A name used in a high level language program to store values of a particular entity (ex.) NAME,SALARY,AGE etc. can be used to store the name, salary and age of employees in a company database file.

Input Device: Devices through which data can be sent into the computer, like the keyboard. If there is a sound card sound data can be input through a microphone or by a line from a tape recorder.

Interpreter: A language translator which converts the high level language instructions line by line into machine instructions, executes the instructions immediately and then goes [illegible] a compiler it does [illegible] converted instructions. (Ex. BASIC) To run a program written in an interpreted language, the interpreter is always required.

Kilobyte: 1024 bytes

Language: Generally used to refer to high level languages in which instructions can be written in an English like manner. To convert these instructions into machine code we need a language translator (a compiler or interpreter).

LSI: Large Scale Integrated Circuit. Contains hundreds of Transistors and other electronic components packed in a small space.

Megabyte: One million bytes (precisely 1024 X 1024 bytes).

MIDI: Musical Instrument Digital Interface. Midi enables music played on electronic keyboards to be stored in the computer.

MS-DOS: Micro Soft Disk Operating System. The most popular Operating System used in IBM PC's and compatible machines.

MULTIMEDIA: Using the computer to display text, graphics (pictures), animation (moving pictures) and sound at the same time.

Operating System: An important System Software which makes the computer ready to receive instructions from the user and enables him to run the programs, store and retrieve data etc.

Output Device: A device to which data from the computer is sent, like a printer, and in the case of computer with a sound card the sound card system with its speakers will be an output device to which the sound is sent. The floppy and hard disks function both as input and output devices.

PASCAL: A high level language popular with Engineering and Scientific community.

Software: Instructions (programs) for running the computer. Can be broadly divided as System Software (Operating System, Language Translators, utilities etc.) and Application Software (programs written for direct use for specific purposes).

System Software: Set of programs generally meant for running the computer and developing other programs for direct use.

Translator : A program which converts instructions written in high level language (called the "Source code") into numbers as understood by the computer (called "object code"). Translators can be Interpreters or Compilers.

Variable : Same as Identifier.

VLSI : Very Large Scale Integrated Circuit. May contain even a million transistors and other electronic components packed in a small area. Also popularly called a "Chip". The PC has many chips of which the main CPU is the most important.